E/CONF.39/A/371
15 Nov.1962
ENGLISH
ORIGINAL : FRENCH

UNITED NATIONS CONFERENCE
ON THE APPLICATION OF SCIENCE AND TECHNOLOGY
FOR THE BENEFIT OF THE LESS DEVELOPED AREAS

Agenda Item: A

Belgium

# BASIC PRINCIPLES OF ANY GENERAL PLAN FOR DEVELOPING NATURAL RESOURCES IN EMERGING COUNTRIES

By N. VANDER ELST,
Ex-director of the Meteorological
and Geophysical Services of the Belgian
Congo and Ruanda-Urundi

Papers have been contributed to the United Nations Conference on the Application of Science and Technology for the Benefit of the Less Developed Areas as working papers for that Conference. They are published as presented by the contributors, and the contents and the views expressed are those of the contributors. (See notes overleaf.)

## NOTES

1. Papers selected for inclusion in General Sessions will be available at the Conference in the following official languages of the United Nations: English, French, Russian and Spanish.

2. Papers selected for inclusion in Specialized Sessions will be available at the Conference in only one of the above official languages.

3. Summaries of all papers, as submitted by contributors, will be available at the Conference in the following official languages of the United Nations: English, French, Russian and Spanish.

4. Papers and summaries will not be available for general distribution in advance of the Conference. They will be published in advance in limited quantities only for the use of delegations of participating governments and of other authorized participants. Post-Conference publication and general distribution of the Conference Proceedings will follow United Nations practices as laid down by the United Nations Publications Board.

# BASIC PRINCIPLES OF ANY GENERAL PLAN FOR DEVELOPING NATURAL RESOURCES IN EMERGING COUNTRIES.

N. VANDER ELST, (x)
Ex-director of the Meteorological and Geophysical Services of the Belgian Congo and Ruanda-Urundi.

## 1. INTRODUCTION : The limitations of human action set by the natural environment.

a) In this century, men grow increasingly aware of the limits which the physical factors of their environment set to their action. Surprisingly, this awareness springs from their increasingly powerful techniques, more accurate forecasts and better knowledge of the natural phenomena which they use or are subjected to. With greater means at their disposal, men are venturing forth to larger and more daring undertakings. Their daring, however, is tempered by an increasing caution. For in the past, when men failed to see and appreciate certain factors or deliberately ignored them in making their plans, they have been taught some terrible lessons.

b) We have too often witnessed human entreprises foundering upon some unpredictable turn of the elements. Perturbations of the natural environment can produce its destruction, disrupt its balance, set off irréversible processes and sometimes even catastrophes. In such entreprises as those involving the water cycle, the transformation of soils, the biosociological equilibrium of animal or vegetable species, some at first beneficial actions have ultimately led to disastrous results which were most serious because least expected.

c) In a world grown too small for men to escape from the earth they have exhausted, in a community of nations where promises must increasingly be kept, carelessness is no longer tolerable in using means which may dangerously affect the life and well-being of men.

d) It is therefore imperative, when developing natural resources, to dispel the false hopes raised by Man's belief in his unlimited technical skill. We must recognize and understand the elements governing the environment in which we intend to act and we must take them as guidance for our plans. Only thus can we make promises we are able to keep, benefit most rationally from our efforts and avoid subsequent disappointments and misfortunes.

e) Any plan of action must have a scientific basis. It includes :

i) first phase : a preliminary survey to list the problems involved and marshal them for careful examination. This first phase is rounded off by the establishment of a general program.

ii) second phase : a thorough study which will provide the experimental data for a down-to-earth and detailed program.

## 2. FIRST PHASE : The preliminary survey and its interdisciplinary nature.

a) The inventory with which the preliminary survey commence is not merely the listing of known resources or adding to that list. Its scope must be far wider. It must include all factors likely to affect the development program. These factors may occur in scientific fields far removed from that in which action will be taken and it will thus be advisable to start with an overall scientific examination of the environment. Such an examination will cover several important scientific disciplines. Their order of precedence appears be as follows :

(x) At present : Deputy director general of the Centre d'Etude de l'Energie Nucléaire (Belgium).

i) firstly physical and physiographical data, the climate in particular, are obtained through the various branches of geophysics, through geology, soil science, geodesy, ...

ii) then biological data, provided by specialized branches of zoology, botany, medical sciences, agronomy and connected fields, ...

iii) and lastly data pertaining to man, from medical science, ethnology, sociology, ...

b) Once this inventory has been drawn up, it will be possible to organize the collection of still missing data according to a priority list to which we shall come back later. It should be pointed out that no economic data are mentioned above because these are generally not premises, but results of the influence of environmental conditions and factors on the technical aspects of each development project. Contrary to some still frequently heard opinions there is thus no urgent need to collect economic data. It would be out of place for instance to estimate the cost price for a new agricultural produce in a preliminary study and thus influence future plans. For at that stage it has not even been established yet what measures should be taken for the new venture, nor has it been calculated to what extent this new activity would transform the land.

c) If one accepts the principle that a preliminary survey is required before embarking upon detailed programs, it goes without saying that no attempt at forecasting results should be made at that stage. Experience has shown how serious the consequences of imperfect forecasts can be which fail to take proper account of some of the natural factors of the problem. Examples come to mind : the destruction of soil through cotton crops in the United States, the failure of the Ground-Nut Scheme in East Africa, etc.

3. FIRST PHASE : The lay-out of the preliminary survey.

a) Since several scientific disciplines are involved, the first survey work runs the immediate risk of scattering efforts and losing sight of its aim. Whereas the viewpoints of many sciences must be sufficiently well represented if nothing essential is to be forgotten, the several fields of investigation must nevertheless be restricted and research directed towards gathering knowledge that is truly necessary to the plan of action. In other words, research needs order, coordination and direction. It is advisable to choose a coordinator from a centrally-placed scientific discipline. For such a central discipline is the hub around which research in other disciplines develops.

b) This central discipline must be chosen with care and according to the nature and importance of the problem. As we are here dealing with the development of natural resources, it seems that the focus to choose in most cases should be the "physics and chemistry of the natural environment". This choice arises from two considerations :

i) A reason of principle : this fields embraces the various branches of geophysics, of geology and of soil science ; it provides information on inescapable matters which are to a large extent beyond human control. If such physical and chemical data are available, the other sciences concerned with the problem can better guide their research.

ii) A parctical reason : those who deal with the physics of the natutal environment, and most particularly climatologists and hydrologists, are generally best able to encompass the wealth of subjects to be studied. Their work has accustomed them to collaborate in agronomical, biological, sociological, medical, industrial and economic studies. This does not mean to say that they are competent in these specialized fields, but they are aware of the links between the various sciences.

4. FIRST PHASE : Scope and organization of the preliminary survey.

a) As described earlier, the team will make an inventory of known resources and also of the information required for proper assessment before embarking upon detailed planning. The team will therefore organize the systematic collection of missing data. This requires two steps :

i) priorities to be established in the search for information. First place will usually be given to four fields at once, where information is always indispensible and sometimes urgent : map, climate, water cycle, soils. Second priority will be given to data on mineral deposits and plant and animal resources. Third come data on population, roads of access and transport, etc.

ii) the collection of data. This means observing, measuring, experimenting, then applying calculations and reasoning to results obtained through observation and experiment. Maps are produced, statistics compiled, empirical laws uncovered ; figures are found to measure parameters which need to be taken into consideration when the general plan is set up. It might be useful to recall that this concerns only essential data to be quickly obtained during the course of the preliminary survey. Such a general prospection aims merely at defining the order of magnitude of the factors involved ; a few teams of experienced specialists and a minimum scientific equipment are sufficient for this purpose.

B) After completing the inventory by field work and the preparation of the results, the team for the preliminary survey will terminate its work by carrying out two further tasks :

i) the team will take part in the setting up of the general plan for the development of natural resources, i.e. in the selection of desirable and at the same time feasible undertakings. This plan consists of a number of specific projects, each of which will probably comprise a program of action and a thorough program of study. These two programs are to be carried out simultaneously.

ii) it will further establish these programs of study for specific projects, group requirements from various projects when they concern the same scientific discipline, prepare the organization of research teams and laboratories if required, establish observation networks or posts, experimental stations, etc.

c) Let us take an example to illustrate this last-named task and let us suppose that a preliminary survey has led to the decision to carry out the two following projects in a little-developed tropical country : 1) a dam on a large river for the generation of electricity and regulation of the water supply for agricultural and cattle-raising pupeses ; 2) the introduction of a new agricultural crop in the region that has thus been hydrologically improved. These decisions have been made on the strength of the preliminary survey which lasted 15 months, let us say, and produced a sufficient amount of information on topography, on the climatic and hydrological conditions of the region, on the soils and the minerals that might be worked thanks to the electric energy thus produced. Each project will have a program which fixes the successive stages of implementation. The work in each of these stages will require far more precise and detailed knowledge than that provided by the preliminary survey.

i) The first project - the dam - will require local topographical and geophysical surveys, geological prospections and borings. When the actual construction starts, there will be problems of diseases and pests eradication, necessitating knowledge on microclimates ; problems of increasing local food crops for the workers, requiring information on climate and soils, etc. This data will have to be collected carefully,

once only. On the other hand, it will be necessary to observe or measure for a good many years, if not permanently, a number of factors which will be used in the later phases of building and operation : rainfall data and the variations of each term of the water-balance in the catchment area, data on erosion and soil transformation, statistics on storms and lightning in relation with power-line protection, etc.

ii) The second project - the new crop - will need good land surveys, levelling, detailed and careful soil prospection, botanical and zoological studies, entomological inventory and a good knowledge of microclimates, etc., all information required only once. In addition, continuous observation of climatological and hydrological elements, as well, as an extensive study of parasites and viruses which may affect the crop or the population producing it, will have to be on a permanent basis and undertaken right from the start of the project.

iii) Thus, the two projects require a number of observations and experiments in various scientific fields and the task of meeting these temporary or permanent requirements will be given to scientific or technical units. These units are embryos of future services : Map, Geological, Geophysical, Hydrological, Medical, Agricultural Services ; their initial organization is the job of the people taking part in the preliminary survey and the units should start operating as soon as the projects get under way. We come now to the second phase of the plan.

5. SECOND PHASE : Specific studies.

a) Having set up scientific or technical units specialized in certain fields does not imply that these groups are going to develop independently of each other. An efficient coordination remains indispensable ; it should do more than ensuring simultaneous operation. A constant watch must be kept upon the progress in each field and mutual help between lines of research must be encouraged. Here are a few examples, all from the field of "physics of the environment".

i) Climate and soil, considered in relation to water resources, are important for widely different subjects such as : drinkable and industrial waters, irrigation, agronomy and animal husbandry, agricultural engineering, inland navigation, hydroelectric plants, soil conservation, etc. The same men, the same methods and equipment, can supply climatological, hydrological or soil data relevant to these problems, provided that the requirements are coordinated and that the observations, the laboratory experiments and the processing of the data have been adequately organized. To achieve this, a close cooperation between technical men in these various fields of activity is necessary.

ii) Climate, considered in relation to medical and sociological problems, affords quite another set of connections with public and industrial health, town and country planning, architecture, pests eradication, work organization, etc. The necessity for coordination and interdisciplinary cooperation is again apparent, as it is in the further examples.

iii) Meteorological forecasting in relation to air navigation, agriculture and a number of industries.

iiii) Geophysical prospecting and geology in relation to minning and civil engineering.

iiiii) Special subjects in Geophysics, in view of their applications, such as : ionospheric studies for telecommunications, research in non-conventional sources of energy (wind, radiation, tides), artificial weather modifications, (induced rain, control of lake evaporation, fog dissipation, etc). Such subjects, undertaken with a view to practical applications can succed only if an intelligent collaboration is maintained between the various fields concerned.

b) The kind of collaboration mentioned above is seldom obtained when technical assistance teams are recruited and set up separately for each project by different agencies, even when there is some high administrative coordination.

The sure result of this unfortunate and current custom is, to begin with, an inefficient use of the financial means. But worse still is the overlapping of efforts in unsystematical collecting of non-homogeneous data for each individual project. A proper knowledge of the country cannot be achieved in this manner, and the training of national personnel is adversely affected, as we shall see.

6. SECOND PHASE : Organizing each field.

a) We shall briefly indicate the principles that should govern the organization of each particular field and thus promote the specific projects mentioned earlier.

i) Unity of command is imperative. To scatter the various geological, hydrological or meteorological activities would lead to duplications and sterile competition. When developing natural resources, the personality of the man who will direct the work in each scientific field must be such that he can understand and appreciate at least in their wider outlines the problems and viewpoints of other fields. This man must, at all events, be practical-minded and determined as well as subtle enough to understand all difficulties that may arise.

ii) It is by no means necessary that this team leader be specialized in the field of the activity he directs. He must, however, be assisted by some experienced specialists and grant them full independance in their respective subject through adequate delegation of authority.

iii) Two kinds of activity will generally be distinguished in the organization od work : research in laboratories and observatories ; field measurements and observations. There is not much to be said about the first kind : they should be restricted to what is necessary and, if they are to be useful, they require the employment of trained specialists from outside, who will get down to work without waste of time. Those activities which are scattered throughout the country, observation posts or stations and field parties, will probably be the more important numerically : they will made wide use of national personnel.

b) The laboratory groups and field parties will necessarily be constituted around the experienced specialized staff. We consider that such staff may be quite small but must be very highly qualified. All the additional personnel should consist of scientists and technicians of the country concerned. And here it is necessary to make a few important remarks.

i) If technical assistance is to have durable effects and go beyond a mere task of setting up equipment, then the men of that country must, at every steps of the project, take the largest possible part in its implementation and in the responsabilities which it carries. The training of these men is, therefore, the crux of the problem.

ii) Let us leave the matter of the general school education, which takes time and does not concern us here, and consider the scientific or technical training which can be acquired by a man while taking part in the study and development of natural resources of his own country. For such training to be possible, the work must be organized accordingly and this may lead to fairly unorthodox solutions.

a. One should not aim at forming a team of highly qualified national university graduates who would undertake the various research subjects under the leadership of a specialist : this is neither realistic nor necessary. On the contrary, it is recommended that each research program be split into tasks in such a way that the level of general knowledge required to fulfill such takes is lowered. A bold spirit and an intelligent analysis of the actual operations can achieve this division of the work. The training of local personnel in very narrow fields can thus be obtained in a very short time. A body of such national specialists, led by a small number of highly qualified men who must be first class organizers, can produce the same research work as a team of expensive technicians and scientists imported at

great cost. The immense advantage of this formula is that men soon take part in the development of their country, with resulting pride and dignity. It can be safety said that no element creates better spirit of confidence and collaboration between the technical personnel of a young nation and the foreigners who provide technical assistance.

b. The organizing of this training has many aspects which all deserve consideration : psychotechnical selection specially designed for the work in view ; courses and practical training in specialized schools with very limited and precise curriculum ; incorporation after 3 to 6 months schooling, of the trainee in field parties conducting a particular type of work ; return to the specialized school after some time spent in such field work ; specialized training abroad and return to a laboratory or field team with an increase of technical responsibility, etc.

iii) Insistence must be placed upon the need for an official recognition of the qualification thus acquired by national personnel during their employment with the project of development. Technical assistance in the use of natural resources is not the proper agency for solving the whole problem of the country's education, but can contribute greatly to its solution. The men who have had the training described above, will justly expect an official recognition of their qualifications and adequate legislation should be brought about to ensure that these qualifications will be assimilated to some of the degrees or diplomas which are granted, or will be one day, by the national establishments of education.

c) The laboratories and field installations having been set up, the teams which process and interpret the data will now have to be organized. Special research or observations of less immediate interest will also be undertaken at this stage. And thus is reached the moment when the importance and nature of the development projects justify the establishment of proper national services, which will take their place in the world community of these services : the Specialized Agencies of the United Nations.

7. CONCLUSION

a) We have attempted to summarize the ideas upon which projects for developing natural resources should be based, when an emerging country requests technical assistance. We have stressed the need for a preliminary scientific survey so that it is possible to draw up a general plan of action which takes into account, with a sufficient degree of confidence, the inescapable factors of the ~~of the~~ environment. The choice of particular projects, among those which seem desirable, can be made with better chances of success and the detailed programs are set up with the collaboration of the team in charge of the preliminary survey.

b) The principle of an operation in two phases should not be rejected on the grounds that it is too slow and costly. Only a small number of specialists are required for the first phase if it is well planned and the coordination of research is a time-saving element. The global approach to the problems involved in the two phases permits the collection of a large amount of data relating to the natural environment : this is a considerable wealth which the development of the country will require sooner or later and the lack of which may paralyse the achievement of some projects.

c) Moreover, the thorough study of the natural environment, first undertaken for specific programs and later systematically extended to many subjects in each scientific discipline, is the only reasonable way of establishing national services and provides scientific and technical training for the local personnel.



1394 E - Nov. 1962 - 1,600